

## NOISE ISOLATION SHEET

### BACKGROUND OF THE INVENTION

#### Field of the Invention

This invention relates to a noise isolation sheet provided to cover a panel, e.g., a door inner panel which is installed inside an automobile door.

#### Description of the Prior Art

As illustrated in Fig. 3, there have been a known method of insulating noise in the interior of a door 60, wherein a felt 2 or urethane is attached to the backside of an interior door trim 1 which is provided to the inner side of a door inner panel, or an urethane-made article is attached to the side of the door inner panel.

For example, the examined utility model application publication No. H5-23375 discloses a door trim which is provided with a pad material made of urethane foam and the like. The published patent application No. H10-119159 discloses a noise isolation cover made of urethane foam.

However, according to the above-described prior arts, the noise insulating effect is not satisfactory because the felt 2, urethane, pad material and isolation cover are all made independently and they are installed merely partially to the side of the door trim 1 or the inner side of the door inner panel.

Further, they had to be partially installed, so that there was a problem that the installation operation was troublesome.

Concerning the above-mentioned problem, the applicant of the present invention previously provided a structure wherein an isolation sheet 20 is provided between a door inner panel 11 and a door trim 12 and wherein the top end of the sheet 20 is secured to an inner weather strip 15 just like a curtain hanging from the upside to the downside (See Japanese patent application No. 2002-57777).

In this structure, the inner weather strip 15 is composed of an installation base 16, seal lip portions 17 and 18 provided up and down for elastically making contacts with a door glass 70 which slides in the upward and downward directions from inner side, and a support portion 19 which is prolonged downwardly from the installation base 16 for supporting the seal lip portions 17 and 18. There are formed a plurality of lip portions 16a and position adjustment protrusions 16b on the upper surface of the installation base 16. The installation base 16 is inserted into a concave portion 13 formed on the upper portion of the door trim 12, while each of the position adjustment protrusions 16b makes a contact with a corresponding step portion 13a for adjusting in a proper position. The door trim 12 is fixed to a door inner panel 11 with clips 50.

According to this structure, there is created two rooms X and Y between the door inner panel 11 and door trim 12 through the intermediary of the isolation sheet 20, so that the noise insulating effect improves compared to the conventional arts which are provided with a felt, urethane, pad material, noise isolation cover and the like. Further, the noise isolation sheet 20 is provided by merely hanging the sheet 20 from the upside to the downside, so that an installation operation is easy.

However, according to the prior art comprising a noise isolation sheet 20, it is likely that water tends to invade from the outside of a car. Further, it is expected to produce a noise isolation sheet which is furnished with better noise insulating and water proofing functions.

Therefore, it is an object of this invention to provide a noise isolation sheet which enables to prevent water from invading from the outside of a car, and to improve a noise insulating property by restraining the outside noise to invade into the interior of a car as well as the interior noise to leak outside of the car, in comparison with the prior art.

## SUMMARY OF THE INVENTION

In order to solve the above-mentioned problems there is provided a noise isolation sheet (100) as claimed in claim 1. The noise isolation sheet (100) partially or wholly covers a panel (11) provided inside a car door (60). The noise isolation sheet (100) is at least a double layer comprising an outer side sheet (101) and an inner side sheet (102). The outer side sheet (101) is a sheet made of a foam body having water absorption of less than 30%, and the inner side sheet (102) is a sheet made of a foam body having water absorption of 30% or more.

There is also provided a noise isolation sheet (100) as claimed in claim 2 wherein the noise isolation sheet (100) is provided to a car door which comprises a door inner panel (11) and an interior door trim (12). The door trim (12) is provided inside the door inner panel (11). The noise isolation sheet (100) partially or wholly covers the door inner panel (11). The noise isolation sheet (100) is at least a double layer comprising an outer side sheet (101) and an inner side sheet (102). The outer side sheet (101) is a sheet made of a foam body having water absorption of less than 30%, and the inner side sheet (102) is a sheet made of a foam body having water absorption of 30% or more.

It will be noted that each numeral in a corresponding parenthesis indicates a corresponding element or item shown in the drawings or preferred embodiment of the invention described hereinafter.

According to the invention, the noise isolation sheet, which covers a panel provided inside a door, is at least a double layer and is provided with an outer side sheet at the outer side thereof having water absorption of less than 30%, so that it enables to prevent water from invading from the outside of a car and to improve the noise insulating property as well.

Further, there is provided an inner side sheet at the inner side which is made of a foam body having water absorption of 30% or more, so that the

noise absorption property in the material can be improved through a wider range in a frequency band.

Moreover, both the outer side sheet and inner side sheet are made of foam bodies so that the noise isolation sheet can be reduced in weight.

### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a sectional view showing a primary portion of a noise isolation sheet according to the preferred embodiment of the invention.

Fig. 2 is a graph showing frequency characteristics of a noise isolation sheet according to the preferred embodiment of the invention and a noise isolation sheet compared with the sheet of the invention.

Fig. 3 is a perspective view showing an outlook of a door comprising a felt according to the prior art.

Fig. 4 is an perspective view showing an outlook of a door comprising a noise isolation sheet according to an invention the applicant of this invention formally filed.

Fig. 5 is an enlarged section view along line A-A in Fig. 4.

Fig. 6 is a perspective view showing a disassembled door to which a noise isolation sheet the applicant of this invention formally filed is installed.

### DESCRIPTION OF PREFERRED EMBODIMENT

A preferred embodiment of the noise isolation sheet 100 according to the invention will be described referring to Fig. 1. Fig. 1 is a section view showing a primary portion of the noise isolation sheet 100 according to the preferred embodiment of the invention. It should be noted that the noise isolation sheet 100 in this embodiment is installed in place of the noise isolation sheet 20 illustrated in Figs. 4 to 6.

The noise isolation sheet 100 according to the preferred embodiment of the invention is provided between a door inner panel 11 installed inside a car

door 60 and an interior door trim 12 installed inside the door inner panel 11, hanging just like a curtain from the upside to the downside, thereby covering the entire portion of the door inner panel 11. (The noise isolation sheet 100 may be arranged to partially cover the inner panel 11 instead.)

The noise isolation sheet 100 may be fixed with sealer, clips and the like at the end portion thereof.

The noise isolation sheet 100 is secured to the door inner panel 11 or door trim 12 at the top edge thereof. The door trim 12 is fixed to the door inner panel with clips 50. As illustrated in Fig. 5, the noise isolation sheet 100 may be secured to the inner weather strip 15, which is secured to the door trim 12, at the upper end thereof. (In this case, the inner weather strip 15 may be secured to the door inner panel 11 instead of the door trim 12.) There may be provided slits in the noise isolation sheet 100 for mounting a door handle as well as a harness and lock relating to a power window system to the door panel in an installation operation to easily remove therethrough.

As illustrated in Fig. 1, the noise isolation sheet 100 is a double layer comprising an outer side sheet 101 provided at the outer side thereof and an inner side sheet 102 provided at the inner side thereof. The outer side sheet 101 is a sheet made of a foam body having water absorption of less than 30%, while the inner side sheet 102 is a sheet made of a foam body having water absorption of 30% or more.

The outer side sheet 101 includes, for example, a foam body having a plurality of closed cells which are dotted inside thereof, and having water absorption of less than 30%.

The inner side sheet 102 includes, for example, a foam body having a plurality of closed cells as well as continuous cells 112 which are formed with some of the closed cells adjacently taking place and communicating with each other, and having water absorption of 30% or more.

The noise isolation sheet 100 is roughly rectangular and it is made,

though not critical, of those materials such as EPDM, CR, SBR, NBR and the like. Among those materials, it is preferable to choose EPDM in a point of view that it is highly foamed easily and is easily controlled in fixing a density thereof into a desired one. When EPDM is used, for example, it is preferred that the density thereof is fixed to 0.10 to 0.15.

The noise isolation sheet 100 may be made of a laminated sheet comprising at least two layers, which includes a sheet made of a foam body having water absorption of less than 30% and a sheet made of a foam body having water absorption of 30% or more, wherein both sheets are bound together with an adhesive agent, clips or the like. Further, the noise isolation sheet 100 may be formed by a process of placing two particular sheets in a mold, wherein water absorption of either one is to become less than 30% and that of the other is to become 30% or more after a vulcanization process, followed by a process of heating the sheets to unify each other. Moreover, there is another method of forming the noise isolation sheet 100 wherein a sheet having at least two layers is formed by co-extrusion and is heated to form a laminated sheet having a plurality of layers.

With the noise isolation sheet 100 formed in any one of the methods described above, there is provided two rooms between a door inner panel 11 and a door trim 12 through the intermediary of the sheet 100, so that the noise insulating property improves.

It will particularly be noted that the noise isolation sheet 100 is a double layer including a sheet 101 having water absorption of less than 30%, so that water is prevented from invading from the outside and the noise insulating property can be improved.

Further, the noise isolation sheet 100 comprises a sheet 102 at the inner side of a car having water absorption of 30% or more, so that the noise absorbing property in the material can be improved through wider range of a

frequency band.

It will be well understood from the experimental result as illustrated in Fig. 2, that the noise isolation sheet (the sheet 100 described in the preferred embodiment of the invention) composed of an outer side sheet 101 having water absorption of less than 30% and an inner side sheet 102 having water absorption of 30% or more is higher in the noise absorption coefficient in the high frequency band of 500Hz to 6400Hz compared to the sheet composed merely of an outer side sheet 101 having water absorption of less than 30%. Particularly, the noise absorption coefficient of the sheet 100 exhibits the peak value of 0.7 around the frequency of 2500Hz.

It will be noted that the noise isolation sheet 100 according to the preferred embodiment of the invention are composed of two layers including the outer side sheet 101 and the inner side sheet 102 though, the sheet 100 may be formed of more than two layers to further improve the water proofing and noise insulating effects.